

Answer Key

1. 4

2. 2

3. 1

4. 3

5. 4

6. 3

7. 3

8. 1

9. 4

10. 2

Team \_\_\_\_\_

ANS

## FERMI QUESTIONS

Enrico Fermi prided himself on being able to estimate, within a small margin, the order of magnitude for an "unsolve-able question." The following questions will test your team's ability to do the same.

Object: To estimate the order of magnitude of a quantity, which is difficult or impossible to measure.

Rules:

A single set of answers will be submitted from each team. All answers must be recorded in order of magnitude format. (For example,  $10^4$  NOT  $3 \times 10^4$ )

Scoring:

Ten points will be awarded for each correct answer. There will be 1 point off the maximum of ten points for each order of magnitude your answer differs from the accepted answer.

	ANSWER	SCORE
1) How long would it take for a man to crawl to the moon (in days)?	$10^4$	8
2) How many revolutions will a 14-inch tire make during a trip across the continental U.S.?	$10^6$	
3) How many milk cows are there in the United States?	$10^6$	
4) As the Voyager spacecraft flew by Saturn recently, it sent signals back to Earth. How many hours did it take such signals to reach Earth?	$10^0$	
5) Given a candle that is the diameter of a small birthday candle, but five miles high, how long would it burn (in days)?	$10^3$	
6) How many drops of water (medicine dropper size) are there in Lake Erie? <sup>sq ft</sup> <sup>depth</sup> $100 \text{ miles} (10^2 \text{ long}) \times (10^1 \text{ mile wide}) \times 10^3 (10^4) \times 10^2$	$10^{18}$	
7) How many grains of rice are eaten in China during a typical day? $10^9$ <sup>chinese people</sup>	$10^{14}$	
8) Estimate the number of iron atoms in the head of a pin.	$10^{20}$	
9) How many electrons are in an adult human body? $0.1 \text{ Kg} \sim 10^1 \times 10^{24} \text{ atoms} \times 10^{10} \text{ electrons}$ <sup>water average</sup>	$10^{28}$	
10) If our national debt were distributed uniformly among the citizens of this country, what would be the amount in dollars that a typical family would have to assume?	$10^4$	

B4

**Conversion Practice  
Answer Section**

**MULTIPLE CHOICE**

1. D
2. C
3. B
4. B
5. C
6. B

General Mathematics Used in Physics

**Answer Key -- Genmath**

- |       |       |
|-------|-------|
| 1. C  |       |
| 2. B  |       |
| 3. A  |       |
| 4. D  |       |
| 5. D  |       |
| 6. A  |       |
| 7. E  |       |
| 8. B  |       |
| 9. C  |       |
| 10. A |       |
| 11. B |       |
| 12. D |       |
| 13. C |       |
| 14. E |       |
| 15. D |       |
| 16. B |       |
| 17. B |       |
| 18. A |       |
| 19. E |       |
| 20. E |       |
| 21. D |       |
| 22. A |       |
| 23. B |       |
| 24. C |       |
| 25. E |       |
| 26. B |       |
| 27. A |       |
| 28. D |       |
| 29. A |       |
| 30. C |       |
| 31. D |       |
| 32. A |       |
| 33. D |       |
| 34. B |       |
| 35. B |       |
| 36. E |       |
| 37. A |       |
| 38. E |       |
| 39. A |       |
| 40. D |       |
|       | 41. A |
|       | 42. E |
|       | 43. C |
|       | 44. B |
|       | 45. B |
|       | 46. A |
|       | 47. D |
|       | 48. C |
|       | 49. A |
|       | 50. B |
|       | 51. C |
|       | 52. E |
|       | 53. D |
|       | 54. C |

B6-B2D

## Answer Key

1. 22. 33. 14. 15. 46. 17. 48. 29. 310. 111. 312. 413. 214. 215. 416. 317. 218. 219. 320. 2

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B21-23

**Answer Key -- 1D Kinematics**

1. C
2. C
3. B
4. D
5. E
6. C
7. C
8. B
9. D
10. B
11. C
12. A
13. B
14. B
15. A
16. B
17. E
18. A
19. D
20. A
21. E
22. C
23. E
24. D
25. D

B24-B30

## Answer Key

1. 42. 13. 34. 15. 16. 47. 28. 49. 310. 411. 312. 213. 314. 115. 216. 417. 118. 319. 220. 2

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B31-B36

## Answer Key

1. 22. 33. 14. 35. 16. 17. 18. 39. 310. 211. 212. 413. 314. 315. 416. 117. 218. 319. 220. 1

C3-C6



## Answer Key

1. 42. 23. 24. 35. 26. 37. 18. 49. 310. 111. 112. 213. 214. 415. 216. 317. 418. 319. 120. 421. 122. 423. 124. 225. 126. 227. 228. 429. 230. 431. 432. 233. 334. 235. 236. 137. 238. 4

**Answer Key -- forces**

1. B
2. D
3. C
4. C
5. A
6. E
7. D
8. A
9. C
10. D
11. B
12. B
13. E
14. D
15. A
16. C
17. C
18. A
19. B
20. B
21. C
22. A
23. A
24. E
25. C
26. D
27. A
28. E
29. B
30. A
31. C
32. B
33. D
34. B
35. B
36. E
37. B
38. A

C14-C26.

## Answer Key

1. 12. 33. 44. 45. 26. 37. 18. 39. 210. 211. 112. 213. 114. 115. 2

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D3-D8

## Answer Key

1. 12. 43. 24. 35. 26. 37. 18. 49. 110. 211. 312. 213. 114. 415. 416. 117. 218. 119. 220. 221. 122. 123. 324. 3

D9-D16

## Answer Key

1. 12. 43. 34. 35. 26. 37. 38. 39. 210. 111. 212. 413. 214. 115. 416. 417. 218. 119. 420. 4

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*E2-E5*

## Answer Key

1. 22. 23. 44. 45. 46. 37. 28. 29. 210. 111. 112. 213. 414. 315. 316. 3

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*E6-E7*

## Answer Key

1. 3
2. 1
3. 1
4. 3
5. 3
6. 3
7. 2
8. 4
9. 3
10. 4
11. 4
12. 3
13. 3
14. 3
15. 3
16. 3
17. 3
18. 4

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**E8-E11**

## Answer Key

1. A) Graph  
B) substitution into the formula  $P = W / \Delta t$   
C) 2.5 s (+,-) 0.3 s
2. graph
3.  $W = F \cdot \Delta s$
4. The slope is the average speed of the safe.  
The slope is the velocity  
The change in distance divided by the change in time is equal to the velocity.  
The slope is the speed of the safe.
5.  $F = kx$   
 $6.0 \text{ N} = k(0.040 \text{ m})$
6. A)  $\Delta PE = 3200 \text{ J}$   
B)  $KE = 2700 \text{ J}$   
C) The difference for what the student calculated in part a and b  
D) The energy was lost due to air friction  
or  
The energy was converted to heat energy  
or  
The energy was lost due to friction  
or  
Work was done on the air by the block.  
or The energy was lost due to work done against friction.

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E12-E15



## Answer Key

1. 32. 13. 44. 15. 16. 37. 48. 39. 110. 311. 312. 413. 314. 215. 316. 417. 418. 219. 320. 321. 122. 123. 324. 325. 426. 327. 328. 229. 230. 4

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F2-F6

Advanced Momentum: elastic & inelastic & 2D collisions

**Answer Key**

1. B
2. E
3. A
4. D
5. C
6. A
7. B
8. A
9. C
10. E
11. D
12. B
13. E
14. E
15. B
16. D
17. A
18. E

**Springs, Pendulums & Oscillations**  
**Answer Section**

**MULTIPLE CHOICE**

1. D
2. D
3. D
4. D
5. A
6. B
7. B
8. A
9. E
10. C
11. B
12. B
13. D
14. B
15. E
16. B
17. B
18. C

<sup>1</sup>G3-G6

**Torque & Static Rotational Equilibrium**  
**Answer Section**

**MULTIPLE CHOICE**

1. B
2. D
3. C
4. A
5. C
6. B
7. A
8. D
9. B
10. B
11. C
12. D
13. A
14. C
15. A
16. D

**Torque & Angular Momentum  
Answer Section**

**MULTIPLE CHOICE**

1. C
2. A
3. D
4. C
5. D
6. B
7. B
8. B

## Answer Key

1. 12. 33. 24. 45. 16. 27. 48. 49. 110. 311. 412. 3

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*I2-I5*

## Answer Key

1. Graph or  
5 Newtons
2.  $5.0 \text{ m/s}^2$  south
3. graph
4. graph
5. graph
6. 1
7.  $2 \text{ m/s}^2$
8.  $40 \text{ m/s}$
9. A)  $6000 \text{ kg}\cdot\text{m/s}$   
B) Drawing  
C) After collision momentum is zero.  
Total momentum before and after the collision is zero.
10.  $a = 4.0 \text{ m/s}^2$   
or  
 $a = 4 \text{ N/kg}$
11. drawing
12. Essay
13.  $a = 4.5 \text{ m/s}$   
or  
 $a = 4.5 \text{ N/kg}$
14.  $27^\circ$
15. diagram
16.  $5.0 \text{ N}$
17.  $\Delta PE = 152,880 \text{ kg}\cdot\text{m}^2/\text{s}^2$   
or  
 $\Delta PE = 1.5 \times 10^5 \text{ J}$
18. The kinetic energy of the car at the top of the second hill is less than the kinetic energy of the car at the top of the third hill.  
or  
The car's KE is less.
19. A) [1] Drawing  
[2] Drawing  
B)  $361 \text{ m (+, -) } 15 \text{ m}$   
C)  $56^\circ (+, -) 2^\circ$
20. a  $v = \frac{\Delta x}{\Delta t}$   
 $\lambda = \frac{v}{f}$   
 $= \frac{1.5 \times 10^3 \text{ m/s}}{5.0 \times 10^3 \text{ Hz}}$   
 $= 0.30 \text{ m}$   
or  $1.5 \times 10^3$   
 $\frac{1.5 \times 10^3}{5.0 \times 10^3}$   
 $3.0 \times 10^2$   
b  $\bar{v} = \frac{\Delta x}{\Delta t}$   
 $1.5 \times 10^3 \text{ m/s} = \frac{\Delta x}{2 \text{ s}}$   
 $\Delta x = 3 \times 10^3 \text{ m}$

J1-J9